Remarks

Claims 1-3 and 5-10 are pending herein. By this Amendment, claim 4 has been canceled, claims 1 and 3 and the specification have been amended, and new claims 9 and 10 have been added.

Claim 1 has been amended to include the contents of canceled claim 4. Claim 3 has been amended to correct a misspelled word and to incorporate proper Markush language.

The specification has been amended to correct misspelled words, and minor grammatical and typographical errors.

New claim 9 depends upon claim 1 and recites that the oxidizing gas and the reducing gas are fed into the processing container respectively by separate gas feed locations, wherein a distance between a wafer-accommodating region in the processing container and each of the gas feed locations is 100 mm or more. Support for new claim 9 can be found in the specification at, e.g., page 8, line 28 – page 9, line 5.

New claim 10 depends upon claim 1 and recites that the oxidation forms SiO_2 on said nitride film. Support for new claim 10 can be found in the specification at, e.g., page 12, lines 16, 20 and 28.

In the Office Action, claims 1, 2, 3, 5 and 6 are rejected under 35 U.S.C. §102(a) as being anticipated by EP Patent No. 1152461 to Shoichi et al. ("Shoichi"); and claims 4, 7 and 8 are rejected under 35 U.S.C. §103(a) as being unpatentable over Shoichi in view of U.S. Patent No. 6,114,258 to Miner et al. ("Miner").

In view of the amendments and remarks herein, Applicants respectfully request reconsideration and withdrawal of the rejections set forth in the Office Action.

I. Rejection of Claims 1, 2, 3, 5 and 6

As noted above, claims 1, 2, 3, 5 and 6 are rejected under §102(a) as being anticipated by Shoichi.

Claim 1 has been amended to include the contents of canceled claim 4. Claims 2, 3, 5 and 6 and new claims 9 and 10 depend directly or indirectly upon claim 1.

Amended claim 1 recites that a nitride film and silicon are both exposed on the surface of the object to be processed. As acknowledged in the Office Action at page 4, second paragraph, Shoichi does not teach this feature.

Therefore, for at least this reason, Applicants respectfully submit that Shoichi does not anticipate amended claim 1 and claims 2, 3, 5, 6, 9 and 10.

II. Rejection of Claims 4, 7 and 8

Claims 4, 7 and 8 are rejected under §103(a) as being unpatentable over Shoichi in view of Miner.

Claim 4 has been canceled and its contents incorporated into claim 1. Claims 7 and 8 both depend upon claim 1.

Applicants respectfully submit that claims 1 and 7-10 would not have been obvious over Shoichi in view of Miner.

Regarding claim 1, Shoichi is cited for teaching a method for oxidation of a surface of an object to be processed, involving performing oxidation wherein an active hydroxyl species and active oxygen species are mainly used in a vacuum atmosphere, a processing pressure is determined to be 133 Pa or below, and a processing temperature is determined to be 400°C or above (see page 3, paragraphs [0013]-[0024]).

According to the Office Action, Shoichi does not teach the feature of a nitride film and silicon being both exposed on the surface of the object to be processed.

Miner is cited for disclosing a method of oxidizing a substrate, wherein a nitride film and silicon are both exposed on the surface of the object to be processed (see col. 4, lines 27-49).

According to the Office Action, it would have been obvious to use the oxidation process taught in Shoichi in the Miner process "for its known benefit of oxidizing nitride film and silicon."

Applicants respectfully submit that claims 1 and 7-10 would not have been obvious over Shoichi in view of Miner. Specifically, Applicants submit that the oxidation method taught in Shoichi and Miner differ too much for any portions thereof to be interchangeable.

Shoichi teaches that its oxidation method produces

> active hydroxyl and active oxygen species by the interaction of the oxidative gas and the reductive gas; wherein surfaces of workpieces placed in the processing region are oxidized by the active hydroxyl and the active oxygen species (col. 4, lines 29-33).

Shoichi also teaches the following:

> since the oxidation process is carried out in a vacuum atmosphere of a pressure which is far below a process pressure of the conventional oxidation method, the aforesaid reactions represented by the chemical formulas ***proceed gradually*** while oxygen gas and hydrogen gas flows upward in the processing vessel 8, proper amounts of H2O, O* (active oxygen species) and OH* (active hydroxyl species) are supplied to all the wafers W regardless of the height of the wafers W [emphasis added] (col. 9, lines 41-50).
>
> Since oxygen gas and hydrogen gas are supplied into the position which is located distance H1 apart from the lower end of the processing space S ***instead of supplying the same directly into the processing space S***, the gases mix satisfactorily and are preheated by the ***heat radiated by the hot wall*** of the processing vessel 8 heated by the heater 62 ***while the same flow through the distance H1, which promotes the activation of the gases*** [emphasis added] (col. 10, lines 17-24).

Thus, in Shoichi's oxidation method:

> - active hydroxyl and active oxygen species are formed and are the desired products of the reaction between the oxygen and hydrogen gases;
>
> - the oxygen gas and the hydrogen gas are supplied into the position located distance H1 from the lower end of the processing space S rather than supplied directly into the processing space S;
>
> - the oxygen gas and the hydrogen gas are pre-heated by the hot wall of the processing vessel; and
>
> - the reactions forming the active species occur gradually as the gases flow up the processing vessel.

On the other hand, in the Miner oxidation method:

> - steam or moisture is the desired product of the reaction between the hydrogen gas and the oxygen gas although hydroxyl radicals may also exist (col. 10, lines 61-62);
>
> - the oxygen and hydrogen gases are injected directly into process chamber 213 via gas inlet 269 (col. 6, lines 25-27); and
>
> - since the RTP apparatus 200 is a "cold wall" reactor, the only sufficiently hot surfaces in chamber 213 to initiate the reaction are

> substrate or wafer 100 and support ring 262. As such, in the invention, the moisture or steam generating reaction occurs near, e.g., about one centimeter from, the surface of substrate or wafer 100 (col. 9, lines 45-50).

Thus, the Shoichi oxidation method and the Miner oxidation method differ in at least the following respects:

> - the desired primary reaction products in Shoichi are active hydroxyl and active oxygen species, whereas the desired primary reaction product in Miner is steam or moisture;
>
> - the hydrogen and oxygen gases in Shoichi are supplied into the position located distance H1 from the lower end of the processing space S, whereas the hydrogen and oxygen gases in Miner are supplied directly into the processing space;
>
> - the oxygen gas and the hydrogen gas in Shoichi are pre-heated by the hot wall of the processing vessel, whereas Miner uses a "cold wall" reactor and the only sufficiently hot surfaces to initiate the reaction are substrate or wafer 100 and support ring 262; and
>
> - in Shoichi, the reactions forming the active species occur gradually as the gases flow up the processing vessel, whereas in Miner, the moisture or steam generating reaction occurs near, e.g., about one centimeter from, the surface of substrate or wafer.

In view of the differences between the Shoichi oxidation method and the Miner oxidation method, Applicants respectfully submit that one skilled in the art, who wishes to process an object wherein a nitride film and silicon are both exposed on the surface of the object, would not be given any reason, suggestion or motivation to modify any part of the Shoichi oxidation method to incorporate a feature from the Miner oxidation method, in order to process such object.

Thus, for at least the foregoing reasons, Applicants respectfully submit that 1 and 7-10 would not have been obvious over Shoichi in view of Miner.

In addition, Applicants submit that new claim 9 (which depends upon claim 1 and recites that the oxidizing gas and the reducing gas are fed into the processing container respectively by separate gas feed locations, wherein a distance between a wafer-accommodating region in the processing container and each of the gas feed locations is 100 mm or more) is patentable over

Shoichi in view of Miner for the additional reason that Miner teaches that the hydrogen and oxygen gases therein are supplied directly into the processing space.

Applicants also submit that new claim 10 (which depends upon claim 1 and recites that the oxidation forms SiO_2 on said nitride film.) is further patentable over Shoichi in view of Miner. Miner teaches at col. 4, lines 49-53, that the reoxidation process therein "forms an oxide (SiO_2) at the interface. In other words, SiO_2 is formed at the boundary between Si_3N_4 or $Si_xN_yO_z$ film 110 and substrate 100 to form a SiO_2/Si interface." As set forth in new claim 10, Applicants' claimed method forms SiO_2 on the surface of the nitride film. Shoichi does not teach the use of a nitride film. Thus, Shoichi in view of Miner does not teach or suggest the formation of SiO_2 on a nitride film.

III. Conclusion

In view of the amendments and remarks above, Applicants respectfully request that the rejections set forth in the Office Action be withdrawn and that claims 1-3 and 5-10 be allowed.

If any additional fees are due in connection with the filing of this paper, such as fees under 37 C.F.R. §§1.16 or 1.17, please charge the fees to Deposit Account 02-4300; Order No. 033082R235.

Respectfully submitted,

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Enclosures: (1) Petition for Extension of Time (Three Months)
(2) Check for the sum of $1020